Polymer impregnation of cast gypsum

Polymer impregnation has been used to improve the mechanical properties of porous solids such as Portland cement, mortar, concrete and ceramic tile bodies [1-3]. The materials are impregnated with a liquid monomer, which is then polymerized *in situ*.

Since cast gypsum prepared from a plaster of Paris slurry is also porous, experiments were made to determine whether polymer impregnation of this material would confer a worthwhile improvement in mechanical properties. Cast gypsum is deficient particularly in tensile strength [4] and abrasion resistance [5], so these two properties were used as a basis for comparison.

Test specimens were prepared from an unmodified industrial casting plaster, mixed in a water/powder ratio of 0.50. The slurry was vibrated into gang moulds to form right circular cylinders 25 mm in diameter by 13 mm high, which were dried to constant weight at $40 \pm 1\,^{\circ}C$. Control specimens were tested in this condition, while the remainder were impregnated with poly(methyl methacrylate) in the following manner: specimens were immersed in methyl methacrylate monomer containing 2% wt/wt benzoyl peroxide. When saturated (10 min) they were individually wrapped in tin foil, heated to $70 \pm 1\,^{\circ}C$ for 24 h, then slowly cooled to room temperature.

Tensile strength was determined by fracturing specimens in diametral compression, since this method (the "indirect" or "Brazilian" tensile test [6]) has been shown to be valid for cast gypsum [7]. Abrasion resistance was determined by a method based on that described by Mulhearn and Samuels [8]; one of the plane surfaces of the specimen was abraded for 10 min on 180 grade silicon carbide paper, at a speed of 0.5 m sec^{-1}, under a load of 100 g. Volume loss was used as a measure of relative resistance to abrasion.

Results are shown in Fig. 1. It is clear that polymer impregnation of these specimens of cast gypsum produced a considerable improvement both in tensile strength and in resistance to abrasion.

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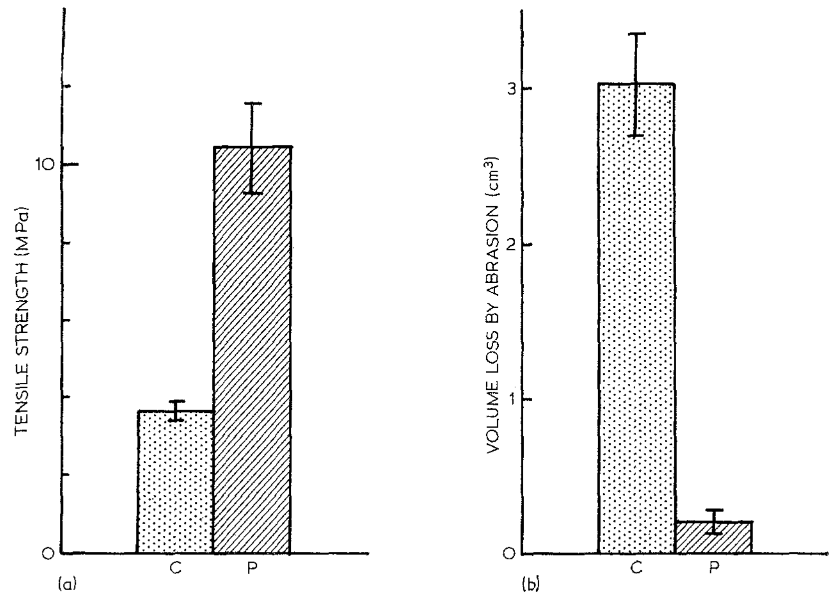

Figure 1 Effect of polymer impregnation on (a) tensile strength and (b) abrasion resistance of cast gypsum. C: control specimens. P: polymer impregnated specimens. Each bar represents the mean of twelve tests, and the superimposed bar shows the standard deviation.

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Short Notices

The Movement of Macroscopic Inclusions in Solids

Ya. Ye. Gyeguzin, M. A. Krivoglaz (in Russian)

Metallurgy Press, Moscow (1971), 344 pp. 88 figs. 171 refs. 2r. 02K ≡ £1.01

A number of reviews and original papers have appeared on particular aspects of the diffusional movement of inclusions in solids but this is the first monograph. The book is largely devoted to the generation of diffusion rate equations for unidirectional movement in the presence of a gradient of temperature, electrical potential, stress or concentration, for modes of movement including diffusion of atoms of the matrix phase around, through or over the surface of inclusions. The mode and rate of movement are functions of the temperature and particle size. The treatment is in three sections: (1) systems in which the matrix phase is an element; (2) two-component systems including alloys and ionic compounds where the diffusion rate equations are more complex; and (3) applications to high-temperature processes.

Movement may modify coarsening in the early stages of the ageing of super-saturated solid solutions, and be responsible for the formation of depleted regions near grain boundaries. The dragging of inclusions by migrating grain boundaries or moving dislocations can also play an important part in recrystallization, grain growth, creep and sintering, and in swelling and gas release in nuclear fuels.

Further interesting relevant examples quoted by the authors are the natural purificaton of frozen sea water by the downward movement of pockets of brine, the movement of conical voids in solid NH_4Cl by a process of evaporation and condensation at rates which could be modified by surface impurities, and the motion of inert gas bubbles in reactor materials in the presence of steep temperature gradients.

The growth of corrosion films is of special interest. In, for example, growing oxide films on iron, the ions of oxygen and iron flow in opposite directions without meeting. The supposition is that one species moves by bulk diffusion and the other by surface or grain-boundary diffusion. Relevant information could be obtained by observing the movement of inclusions in the oxide film. Movement occurs only if there is a net flow of one species in the vicinity of the inclusion. Such movement has been demonstrated in ionic crystals in the presence of a potential gradient.

These examples and the appearance of this book should stimulate a greater interest in this subject and indicate the importance of the phenomenon in materials science. S.F.P.

Introduction to Phase Transitions and Critical Phenomena

H. Eugene Stanley

Clarendon Press: Oxford University Press (1971) £5.00 net, 308 pp.

This book gives a brilliant survey of the concepts and theories used in the discussion of phase transitions and critical fluctuations. For some years, there has been much activity in this field which is of interest to physicists, chemists and materials scientists. The aim of this research is to get an understanding of the different kinds of phase transition in terms of a generalized theory. Stanley's book takes into account this situation well emphasizing the analogies between fluid and magnetic transitions throughout the text. The prerequisites of knowledge are